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Reciprocating IC engine operative on encapsulated fuels - the capsules are metered into engine cylinder where they are ruptured
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A reciprocating piston IC engine is claimed in which encapsulated fuel is admitted to the or each cylinder and the piston reaches top dead centre, the capsules being ruptured e.g. by a spike on the piston or the pressure in the cylinder. The capsules may contain hydrogen, petrol, diesel oil, powdered coal dust or an explosive chemical including its own combustion-supporting oxygen.

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(54) INTERNAL COMBUSTION ENGINE OPERATIVE ON ENCAPSULATED FUELS

(71) I, ARTHUR PAUL PEDRICK, British subject of 77 Hillfield Road, Selsey, Sussex, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:-

This invention is concerned with an arrangement in the design of the usual form of reciprocating piston internal combustion engine, which will make it suitable for use with fuel contained in small capsules, particularly with such capsules containing compressed hydrogen.

It has been pointed out in U.K. patent No. 1,361,962, that it is ridiculous, in a sense, to consider that the World is faced with an "energy crisis", so long as there exist throughout the world large numbers of thermo-nuclear bombs, the deuterium and tritium in which, using the equation $E = mc^2$, doodled out by Albert Einstein in the Swiss Patent Office some 70 years ago, has an energy potential necessary to destroy the whole population of the world about ten times over.

It has been suggested, but cannot be proved without financial resources beyond the means of a "private inventor", that the very great temperatures necessary to initiate a controlled fusion process between deuterium and tritium might be achieved by an arrangement using a system of an odd number of deuterium – tritium tipped high velocity bullets, with the implosion centre fed with high power laser pulses just before the bullets implode.

It is well known that if such a process can be further developed to convert the energy released by interaction of the plasma with an electro-magnetic field, for the generation of an output of electricity, using ultimately only deuterium alone, which can be centrifuged from the vast volumes of sea water in the great oceans, the energy requirements of "mankind" can be met for thousands of years. Such an impliding bullet – laser beam combination plant has been illustrated in the last figure of the drawings of U.K. patent No. 1,361,962 but it is beyond the resources of the writer to construct such apparatus and the cooperation of fusion research laboratories is sought in the assessment of the possibilities of the project described in U.K. patent No. 1,361,962, in so far as this has importance to the "energy crisis".

There are already in existence automobiles running on hydrogen gas, the engines of which do not need much change in design from those running on hydrocarbon fuels, and the great advantage is that since the exhaust comprises steam or water, as compared to the carbon mon and dioxide from gasolene engines, it is obvious that it would be a much "healthier world", if all the world's automobiles and aircraft could be turned over to operation on hydrogen as a fuel. Also, although calculations may show the effect to be quite slight, large numbers of Boeing 747s fitted with hydrogen fuelled large turbo-fan engines, flying over desert areas, would cause considerable quantities of water to condense from the exhaust steam to drop and possibly irrigate a little such areas over which such large aircraft were flying.

It is also clear that if "unlimited" quantities of electricity could be obtained from the fusion of deuterium-tritium or deuterium – deuterium, according to the well known thermo-nuclear reactions, by the common process of the electrolysis of sea water, "unlimited" supplies of hydrogen could be obtained to act as a fuel for transportation processes, and therefore it would seem that the "ultimate" solution of the world's energy requirements lies in the great oceans, and the sooner such a process is made practicable, the sooner would be its effect in reducing world economic inflation which has resulted from the quadrupling of the price of oil fuel, brought about by complex economic and political conditions, particularly in the Middle East.

For the United Kingdom, only about 20% of

the oil imports is used for transportation processes, but if this could be met by a substitution by hydrogen as a fuel, a substantial saving could be made, in a manner perhaps much cheaper than the difficult exploitation of North Sea Oil. However, the use of hydrogen as a fuel for automobiles, has considerable hazards, as liquified hydrogen must be stored under high pressure, and the combination of an automobile towing a trailer of hydrogen bottles may be a somewhat clumsy, or unwieldy, arrangement on the roads.

The invention is therefore concerned with a modification of the cylinder head of a "conventional" form of reciprocating piston internal combustion engine, which could make use of hydrogen, or other fuels, compressed within spherical capsules, and ruptured by, for example, a fitting on the piston head, or the pressure in the space above the piston, at Top Dead Centre position.

The implementation of the "invention", depends, however, on the development of plant also for the production of such fuel pellets on a mass production scale.

In the accompanying drawings:

Figure 1 shows a schematic representation of a fuel capsule on the mass production of which the implementation of the invention depends and,

Figures 2 to 6 show one possible manner in which such fuel capsules might be produced on a mass production scale.

Figure 7 is a schematic representation of an overhead cam shaft form of internal combustion engine, of well known form, with its cylinder head modified to allow the feeding of fuel in the encapsulated form shown in Figure 1.

The invention is intended primarily to enable hydrogen to be used as a fuel for reciprocating piston internal combustion engines, and for this purpose it is proposed to feed in the hydrogen in small spherical capsules 1 as represented in Figure 1, filled with fuel *1'*.

The capsule is to be made of any suitable material, which has at least the following properties:

(1) It must be not easily combustible, or ignited, when stored at temperatures below 100°C or up to about 150°C, if it is to be used in tropical conditions.

(2) When it is burst within the combustion space of an internal combustion engine, after the compression stroke, at such temperatures, the material of the capsule must burn to the extent that it will be exhausted without difficulty through the exhaust port of the engine.

Although primarily intended to contain hydrogen under as high a pressure as possible, the capsule might alternatively be filled with more usual fuels such as

(1) Petrol or gasolene.

(2) Diesel oil fuel.

but other possible fuels are:

(3) Dried powdered coal dust.

(4) Some form of explosive chemical, which includes within its structure its own oxygen constituent.

However, there are a very large number of combustible materials which might be used in the capsule for example a compound including aluminium or magnesium powder. The implementation of the invention depends on the mass production of such capsules, for which there may be many possible methods and that shown in Figures 2 to 6, schematically, may be only one.

As illustrated hemispherical, or half, capsules are formed by injection moulding on a moving belt moving left to right in Figure 2.

In Figure 3, with the mould cores removed, two such mould strips holding half capsules are superimposed and the two halves are pressed together, when heated, by a pair of dies, 4 and 5, which force the two halves into a firm pressure fixture with one another, and the lips cut off to give a good spherical surface.

In Figure 4, the capsules, as formed in Figure 3, have a hole pierced in their top by a piercing element through which air is removed from the capsule.

In Figure 5, each capsule has fed into it through an injection element 8, hydrogen or other fuel supplied at 9.

In Figure 6, the capsules, with their specific filling of fuel, have the hole in their upper surfaces sealed off by some form of reciprocating plunger 11.

It should be understood that the method of mass production of encapsulated fuel, as represented in Figures 2 to 6, is only schematic, and there could be many variations in such a process according to the material chosen for the capsule.

Figure 7 shows the manner in which it is proposed to use the fuel pellets in a conventional form of piston operated internal combustion engine, having overhead cam shafts (16 and 18) which operate the inlet valve *16'* and exhaust valve *18'* in well known manner.

Normally if the engine ran on petrol or gasolene, this would be drawn in through the inlet valve *16'* after passage of the air through a carburettor, or in a diesel, or compression ignition engine, there would be incorporated in the cylinder head a fuel injection valve.

To implement the invention, there is incorporated in the cylinder head, in a bore therein, a very close fitting rotatable cylinder *20*, which has in its surface a number of regularly spaced recesses into which the fuel pellets *1* can feed from some form of reservoir by gravity. This cylinder *20* has to be rotated at such a speed, clockwise as indicated, that on the 4 stroke Otto cycle, one new fuel pellet has to be exposed to the combustion space above the piston 14, each time such piston reaches the Top Dead Centre position on the compression

stroke.

As shown there is mounted at the centre of the piston top, a pointed spindle *15* of tungsten steel, or some high heat resistant material, of just the right length to pierce the fuel capsule *1* in the recess in the rotary cylinder *20* which comes to the position directly in line with the centre line of the piston *14*.

The fracture of the fuel pellet thus feeds into the space above piston *14*, a specific quantity of hydrogen appropriate to the combustion of the air compressed by the piston *14*, the expansion of the air by the heat evolved causing the down ward movement of the piston in well known manner. Parts *23* pressed against the rotor *20* are intended as pressure seals to prevent escape of the combustion gases. Parts *24* in the lower edges of the cylinder head may be made of some material which retain a red heat to heat up the fuel pellets just before they become exposed, for piercing by the element *15*.

It is possible that the fuel pellets may be encapsulated in such a material that it will be burst simply by the pressure attained above piston *14* in the TDC position, in which case there would be no need for the element *15* at all.

Although not shown, there may be needed some form of electrical heated element in the cylinder space to initiate combustion of the fuel, when the engine is starting from cold condition.

As well as for operation primarily on hydrogen, the engine should operate on pellets containing gasolene or diesel fuel, and coal dust, which it is well known if in sufficiently finely powdered condition will ignite spontaneously if thrown into air.

It is possible also that the pellets might contain some form of semi-explosive material, having oxygen in its chemical constituents. In such cases there would be no need for an air entry valve *16'*, and such an engine could form the basis of a power unit for a submarine, of much simpler construction than a nuclear reactor. If the fuel was hydrogen, the exhaust into the sea would be steam or fresh water, but it is unlikely that the performance of such a submarine could give the endurance of a nuclear submarine with its long lasting nuclear energy usage, but such a submarine might be economic for use in diving operations relevant to, for example, North Sea Oil exploitation.

As is clear, the rotor *20* must be made to rotate at an appropriate ratio of speed, in relation to the speed of the engine crank shaft, and as shown, this is brought about by a sprocket chain drive off toothed pinions on the axis of the cams *16* and *18*, but there might be some form of direct drive from the engine output shaft to such rotor *20* or any other suitable form of drive.

In conclusion, of the description of this engine, it will be apparent to anyone throwing a small amount of soft sugar on the fire, that sugar has in fact a very considerable calorific value. At the present time of conception of the present invention, there is apparently a sugar shortage, but at the rate at which patent specifications are published by the long-suffering Patent Office, it is quite probable that by the time this specification is published, if ever in my life time, there may indeed be a "sugar mountain", comparable to the "beef mountain" now being suffered by farmers.

Therefore, if there is a continued rise in the price of oil fuel, it may become quite economic to operate the present engine, as described, on encapsulated sugar, this being it is believed, a novel use for sugar, and comparable to the fact that a conventional automobile engine can be run quite satisfactorily on whisky, but whisky having increased in price as well as petrol, the running of automobiles on whisky has not, so far, become an economic operation.

WHAT I CLAIM IS:

1. A reciprocating piston internal combustion engine in which fuel is fed into the space above the piston at its Top Dead Centre Position after the compression stroke in an encapsulated form, such capsule being ruptured to release the fuel therefrom by, for example, a member movable with the piston or the pressure in the space above such piston.

2. An engine, as claimed in claim 1, wherein fuel pellets or capsules are successively exposed to the space above the piston at the TDC position, by such capsules being positioned in regularly spaced recesses in the surface of a rotor in the cylinder head arranged to rotate in some manner at an appropriate rate in relation to the speed of rotation of the engine crank shaft.

3. An engine, as claimed in claim 1, wherein the encapsulated fuel may be (1) compressed hydrogen gas, (2) petrol or gasolene, (3) diesel or compression ignition fuel, (4) finely powdered coal dust, or (5) a chemical including its combustory oxygen in its chemical structure.

4. An engine, as claimed in claim 1, substantially as described with reference to figure 7 of the accompanying drawings.

A.P. PEDRICK.

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1439440 COMPLETE SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

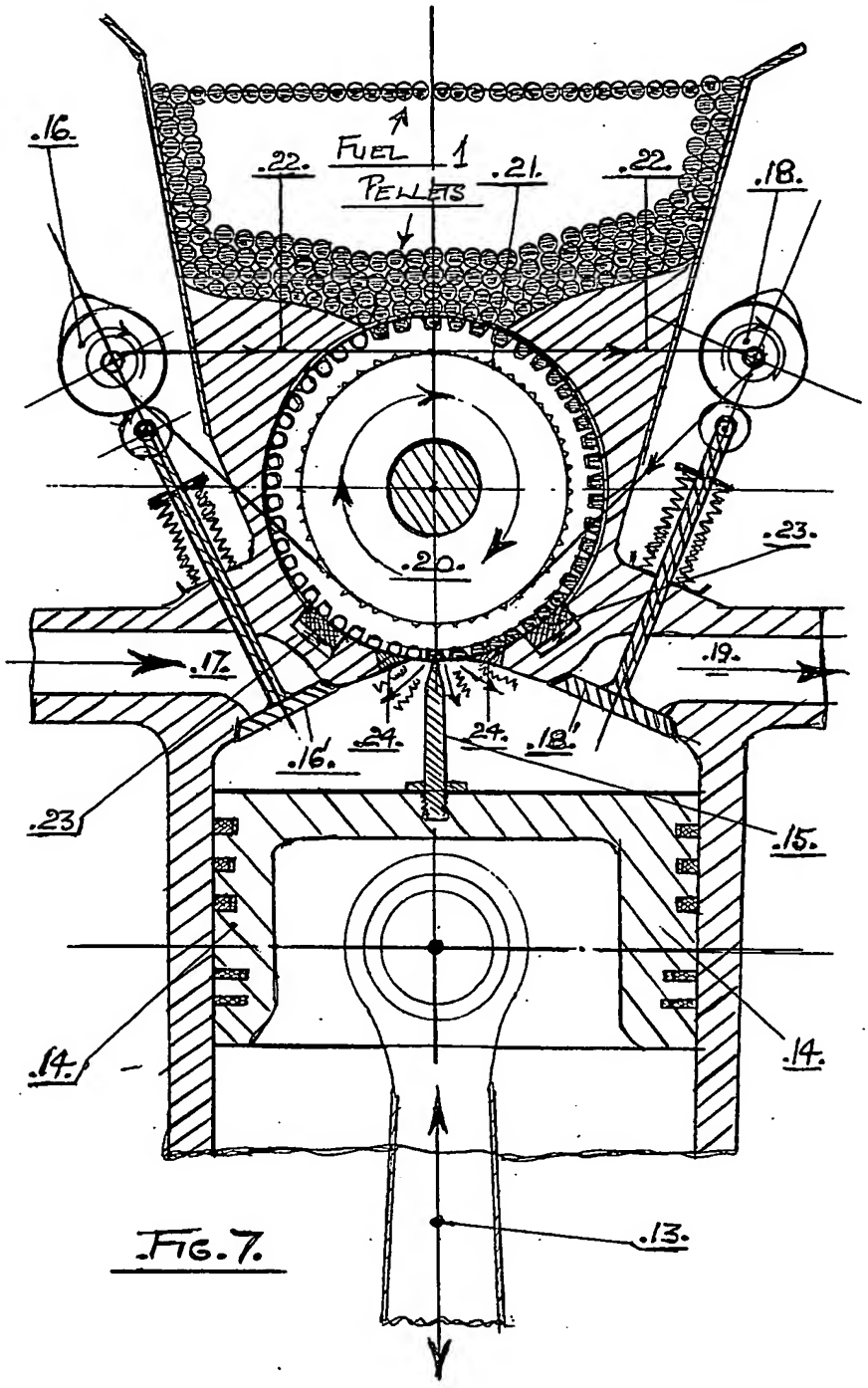

FIG. 7.

1439440 COMPLETE SPECIFICATION
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 2

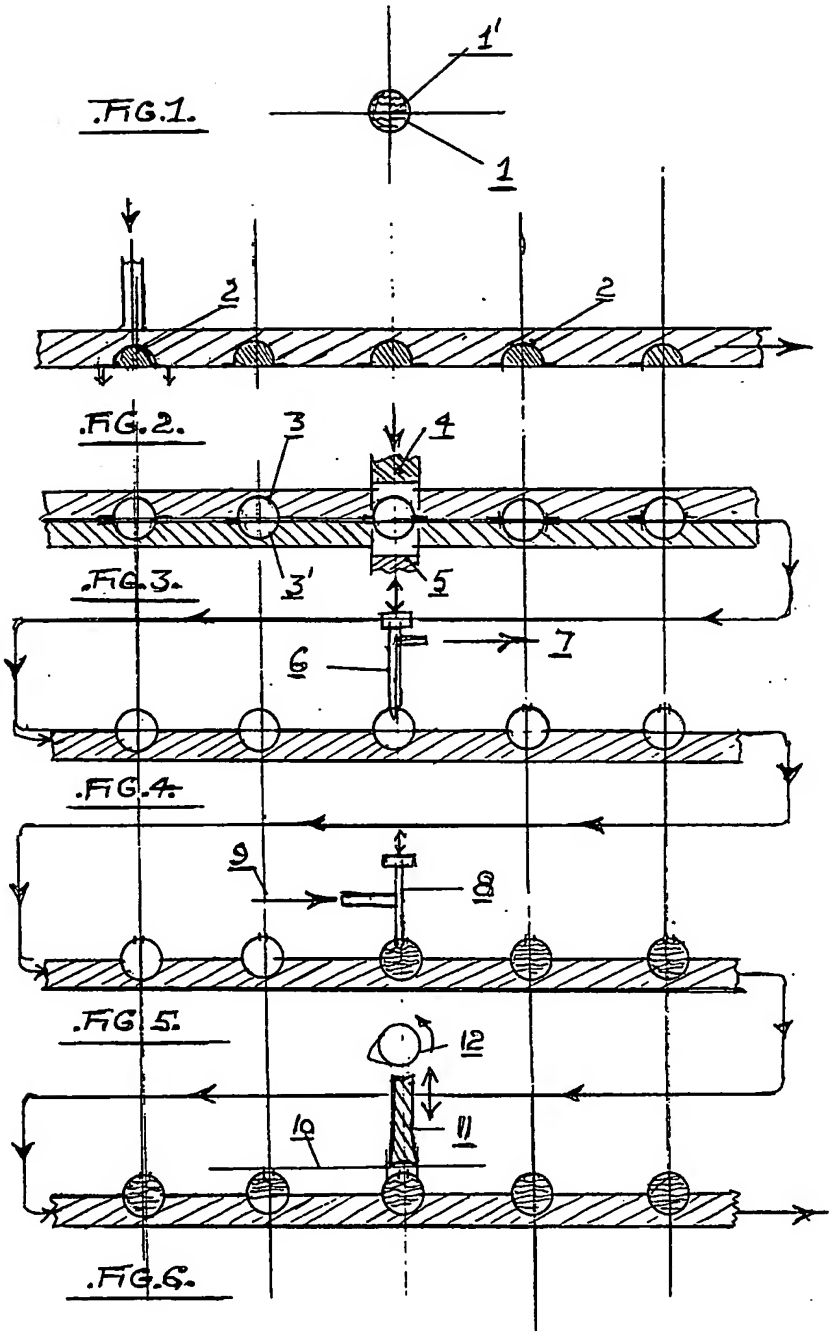

FIG.1.

FIG.2.

FIG.3.

FIG.4.

FIG.5.

FIG.6.